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IoT based Smart Self Tracking Automaton using Arduino

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ABSTRACT

Internet of Things is an upcoming technology that transforms everyday physical objects into an ecosystem that would enrich our life and make it simpler. The problem is formulated using leader-follower pattern. Here, the leader is the person and the follower is the automaton. The automaton uses ultrasonic range detector along with Arduino to follow the expected leader. The ultrasonic range detector measures the distance by transmitting and receiving sound waves which are bounced back by the obstacle. The automaton recognizes the person to be followed using ultrasonic sensors which detect the person through the ecolocation process.

Keywords: *Internet of Things, Ultrasonic Sensors, Arduino, Self-Tracking, Object Detection.*

1. INTRODUCTION

The Internet of things (IoT) is the interconnection of physical devices such as vehicles, home appliances etc. These devices areembedded with electronics and software such as sensors and actuators. This is done to keep the devices connected and enable them to exchange data with one another.

This technology allows us to sense the objects and control them remotely in the current network. This creates an opportunity for us to integrate the physical world into a computer-based systems. This leads to efficiency, accuracy and also benefits economically. When IoT technologies are incorporated with sensors and actuators, this falls under a general class known as cyber-physical systems such as smart homes, smart cities, etc.

These devices are capable of collecting vital data by the means of several existing technologies and tend to make the data flow between the other existing devices.

Robotics is categorized as a branch of engineering which involves design, conception, development and the operation of robots. This branch of engineering combines artificial intelligence, computer science and electronics for their control, the feedback from the sensors and processing the sensed data.

Robots, in general, are constructed based on a frame, form or shape. This is done to achieve a specific task from the robot. Robots constitute of electronic components which are responsible for powering up the machinery. Robots also have a specific level of computer programming language. This code lets the robot decide when and how to do a specific task.

Robotics program can be classified into three types such as hybrid, remote control (RC) and artificial intelligence.
Remote control programming has a set of pre-defined commands which will perform only a specific task and in response when it receives a control signal from the source which is usually a human being with a remote control.
Robots with artificial intelligence communicate with their surroundings without the help of a control source. It uses the pre-existing programs to solve the problems it encounters. By combining AI and RC functions we can obtain a form of programming called Hybrid.

Arduino is a microcontroller or in simple words, it's a minicomputer which is responsible for controlling and managing the functions of the other components present in the existing system. The Arduino code which is constructed and compiled on a software platform called Arduino IDE is fed into this Arduino development board.The Arduino programming language is an object-oriented programming language which is similar to C++. The instructions given to the components are conveyed through this Arduino code.

2. RELATED WORK

There are many studies and underground works on real-time robot tracking and following. Abhishek 881kin-c et al., designed an algorithm based on clustering space-time events induced by a neuromorphic sensor followed by a classification procedure [1]. Ter-Feng Wu et al., ultrasonic sensors are adopted to implement a real-time obstacle avoidance system for wheeled robots, so that the robot can continually detect surroundings, avoid obstacles, and move toward the target area [2]. Takashi Yoshimi et al., Tracking people with stereo vision was a robust algorithm that utilizes various characteristics of the Idata realized by systematizing visual and motion control with a robust algorithm that utilizes various characteristics of the image data[3]. MohanadElshafie et al., A markerless multiple-camera vision-based 3D human tracking method for industrial environments and track humans in the vicinity of moving robots without using 881kin-color cues or articulated human models [4]. Nischay Gupta et al., A unique approach to detect obstacles and avoid collisions using ultrasonic sensors for indoor environment [5].

3. OBJECTIVES

We see many individual carrying the basic amenities like suitcases, duffle bags, cooler, water cans, golf kit bag, cricket kit bags and vendors towing their carts. Carrying these items along is a task. Hence, there is a tremendous need for an automation in our day to day activities to ease the life of commoners. The main objective is to cut down the efforts put by the people in carrying their items.

4. IMPLEMENTATION

The core element of the model is the Arduino board which controls and manages all the functions performed by the other components of the model. The instructions to the components are given through Arduino programming language.

This model consists of the following hardware components:

- Arduino contains both a circuit board and IDE that runs on a computer, which is to write and upload computer code to the Arduino board.
- The motor driver board along with the driver IC L293D is used to control the speed and direction of the wheels.
- The HC-SR04 ultrasonic sensors use sound waves to determine the distance to an object. The determination is done through the ecolocation process.
- The mini server motor is used for rotating the ultrasonic sensors to provide a wider range of object detection.

Along with these components switches and wires are used to develop the prototype.
The ultrasonic sensor determines the distance of the object from the bot through the ecolocation process. In this process sound waves which is transmitted by the sensor is bounced back by the obstacle and received by the sensor. The time difference between the transmission and reception of the sound waves is used to calculate the distance between the objects.

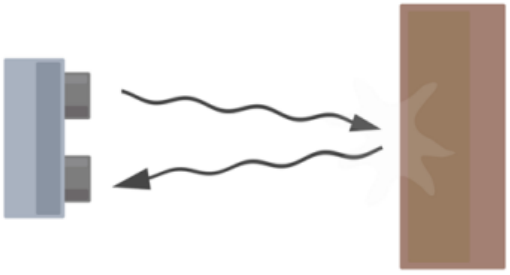

Fig. 1 Ecolocation process

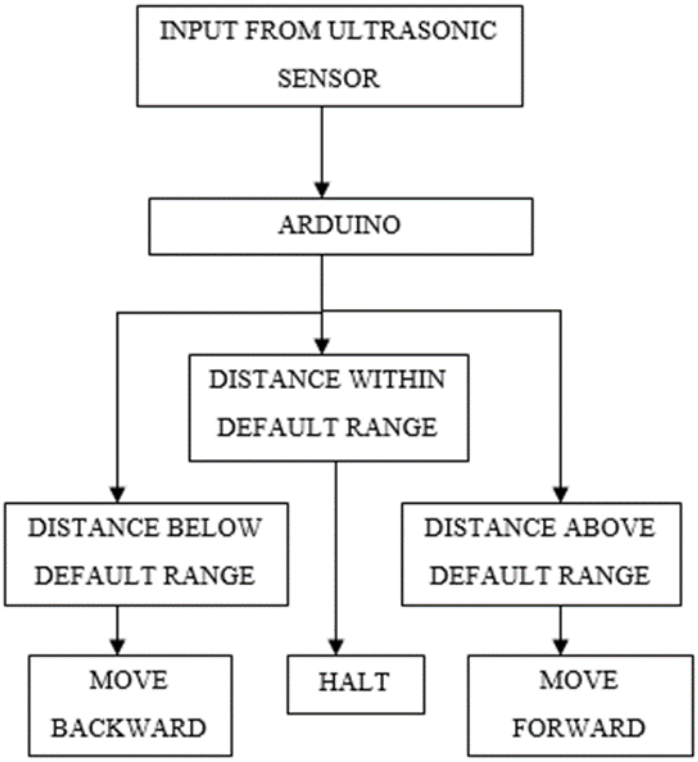

Fig. 2 System Flowchart

The automaton receives the input from the ultrasonic sensor which is sent to the Arduino board. The input is the distance of the object.

- If the distance is below the default range, the automaton moves backward.
- If the distance is within the default range, the automaton halts.
- If the distance is above the default range, the automaton moves forward.

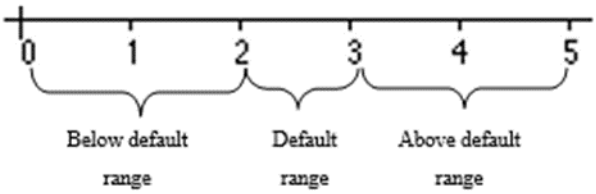

Fig. 3 Example for default ranges

5. HARDWARE DESCRIPTION

A. Ultrasonic Sensors

Ultrasonic sensors (model: HC-SR04), shown in Figure 4 is used for detecting objects. These sensors are of low cost.Ultrasonic sensors contain a receiver and a transmitter for detecting the objects. The sensors can be connected to the microcontroller using a 4-pin interface.

- Pin 1: provides biasing voltage to the sensor (Vcc).
- Pin 2: used to connect to the Ground.
- Pin 3: is called the “trigger” pin.
- Pin 4: is known as the “echo” pin.

Fig. 4 Ultrasonic Sensor

The trigger and echo pins are connected to the analog pins of the Arduino board whereas the vcc and ground are connected to the respective vcc and ground pins on the Arduino board.
When the trigger pin is supplied a high voltage the sensor provides 8 pulses of waves. The sensor receives the waves when it encounters an obstacle in front of it. When the echo pin is high the distance of the object is proportional to the time the pin is high.
Objects distance from sensor = (high level time X velocity of sound (340m/s) / 2.
Objects at a distance of up to 4m can be detected providing a field of vision of 15° in the line of sight on both the sides.

B. Arduino Board

Arduino board has various kinds' of microprocessors and controllers. It consists of a set of analog and digital pins which can be connected to many expansion boards, breadboard, and other circuits. These boards can receive data from a variety of sources, processes the data and provides the output. The feature of the board is serial communication interface or USB used for loading the Arduino code into the board from a personnel computer.

Fig. 5 Arduino board

6. FUTURE SCOPE

This model can be made more secure by providing an access key. This access key ensures that nobody else can access the tracking kits.

Solar cells can be embedded into this kit to make it cheaper and eco-friendly.

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